
THE OCCURRENCE OF GOLD-ORES
IN THE
RAINY RIVER DISTRICT,
ONTARIO, CANADA.

BY WILLIAM HAMILTON MERRITT, TORONTO, CANADA.

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It is a dream of heavenly birth,
A wish that hath no name on earth,
It doth not burn, it doth not melt ;
It is not seen, but it is felt ;
It lifts the soul, but lifts it not
Above the calm controul of thought,
Such is the love that fadeth not,
That may not, cannot be forgot.

Soft is the sigh, and sweet the tear,
To true love's bosom ever dear.
Love doth a pleasing pang impart,
That saddens and refines the heart,
It is a feeling given to few,
For ever warm, for ever true.
This is the love that fadeth not,
That may not, cannot be forgot.

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John Mayne

1875

The Occurrence of Gold-Ores in the Rainy River District, Ontario, Canada.

BY WILLIAM HAMILTON MERRITT, TORONTO, CANADA.

(Colorado Meeting, September, 1896.)

SINCE 1880 the occurrence of gold-ore has been known in the Lake of the Woods district. In 1879 the writer examined a so-called silver-location in the lake. More recent developments have extended, south and east, to the Rainy lake and along the Seine river, which flows from the northeast into the Rainy lake.

The gold occurs in quartz-veins in the Huronian series. These Huronian rocks occur in belts in the Laurentian, which is the predominating formation in the eastern part of Ontario.

The general characteristics of the Huronian rocks in the districts above mentioned are the evidences they carry of great igneous activity. On some of the islands in the Lake of the Woods volcanic ashes have been weathered out most clearly, and lava beds, with which they are interstratified, are equally well-marked. Figs. 1 and 2 show these conditions. Most of the igneous rocks in this locality have been subject to considerable alteration.

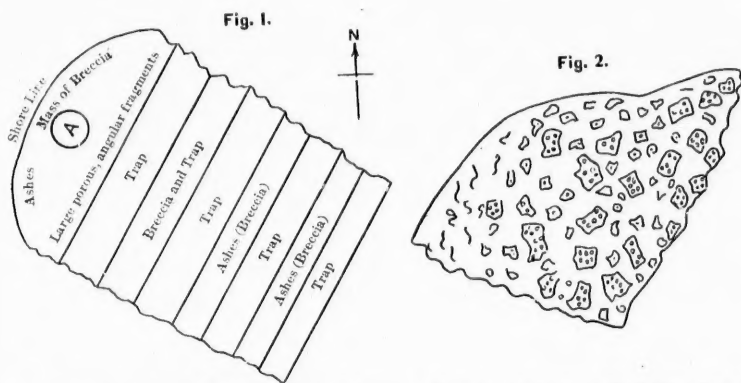
In Schists.—The majority of the volcanic rocks, both eruptive and intrusive, have been highly altered by pressure and chemical action into a series of schists and schistose conglomerates, chiefly of a greenish color. These schists are occasionally accompanied by quartz-veins running with them. The quartz is, for the most part, very irregular in these occurrences, and is generally lens-like in its disposition in the schists. There are exceptions, however, to this rule; as, for example, at Bath Island, where remarkably persistent veins run with the apparent bedding of the schists. (See the description of Rock-section No. 1, under *Examples of Country-Rocks*, below.)

It is noticeable in some instances that the bedding of the

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schists may, indeed, have been set up by pressure after the formation of the veins, or after the action of the forces which gave rise to the fault- or fissure-lines in which they have formed. In two uncertain instances from the Lake of the Woods district, and in another very conclusive one in British Columbia, I have discerned in rock-sections a line of bedding previous to that now adopted by the schistose structure running parallel to the vein.

The minerals in the Lake of the Woods schists have been much crushed, and a great deal of alteration has taken place. Flow-structure and fracturing of the mineral is very commonly noticed in specimens of the wall-rocks. In many instances the quartz infiltrations and bands in schists have, with-



Outcrop of Volcanic Series on Crow Island,
Lake of the Woods, Ontario.

Sketch of Volcanic Tuff Weathered
Out at A, Fig. 1.

out doubt, followed shear-zones, and the quartz-infiltrations occupy the buckles of the formation, as is frequently noticed in the Cariboo schists of British Columbia. It is needless to say that quartz-bodies occurring in this way are very irregular and terminate abruptly; but they are so numerous distributed in some bands of the formation that mining, without doubt, will be prosecuted profitably where the quartz-lenses occur at no great interval from one another.

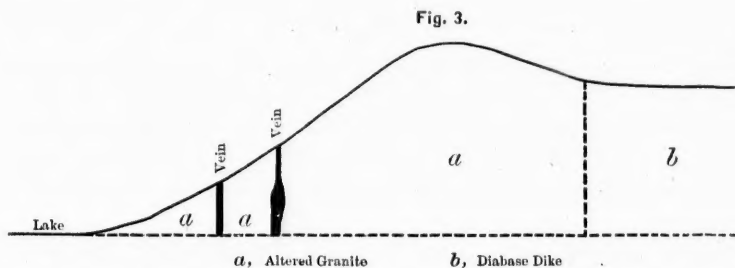
In the Seine River district, stringers of quartz, carrying excellent specimens of free gold, are found running with the schists in many places, and it is confidently expected by the owners that the belts in which they occur will be mined with

profit. This occurrence is probably similar to some of the low-grade rock which is mined in North Carolina.

There is little doubt that the schists, especially in the vicinity of the intrusive granite, are well worthy of attention; and it is altogether probable that belts of schists and quartz-stringers will be mined profitably on a large scale in one or more localities.

No locations in the schists have had much work done upon them in the Seine River district. The gold which has been found on the surface occurs essentially in a free-milling condition. Rock-sections Nos. 2 and 3, under *Examples of Country-Rocks*, below, are other representatives of these schists in which veins occur.

In Granites and Greenstones.—There are also areas of plutonic



Section of Formation at the Sultana Mine, Lake of the Woods, Ontario.

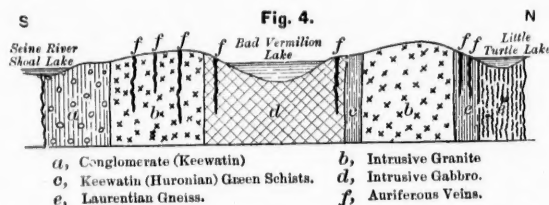
greenstones which retain more or less of their massive characteristics, like the intrusive granite. These are also found to contain quartz-veins, which carry more or less gold. This is true both of the close-grained or greenstone type, as in the case of the country-rock at the Pine Portage mine (Rock-section No. 4, below), and of the coarsely crystallized gabbro type, which is developed in a large area in the vicinity of Lake Bad Vermilion, where the Randolph and other veins carry some high-grade gold-quartz.

Plutonic dikes are found intimately connected with the origin, if not with the mineral contents, of some of the veins. This is notably the case at the Sultana mine, in the Lake of the Woods district, as shown by the diagram, Fig. 3, where it will be observed that a great dike has fractured a porphyritic quartz-syenite, or a granite, which has been squeezed and very con-

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siderably altered, and in which occurs the Sultana vein, running parallel with the trend of the trap (Rock-section No. 5 below). The vein being mined varies from a foot or two up to 40 feet in width, and its mineral contents are chiefly iron pyrites with free gold, milling as high as from \$20 to \$30 per ton.

The most prolific of all rocks in the Rainy River district is intrusive granite, both in its normal condition and altered to the decomposed state of protogene. The granite areas in the Lake of the Woods part of the district are chiefly of the former character. Sometimes the gold-carrying veins occur at or near the junction between granite and greenstone, and sometimes they are found cutting through the granite into the neighboring greenstone. It is noted that the copper contents have increased when in the latter rock. Frequently the schists in the



Cross-Section of Formations, Illustrating the Occurrence of Some Gold-Bearing Veins near Seine River, Rainy River District, Ontario.

vicinity of the granite carry veins which furnish a high-grade of auriferous quartz.

One very interesting occurrence in the gabbro near Lake Bad Vermilion is worthy of note. A large vein of quartz carrying breccia of the wall-rock has again been subject to fracture, chiefly at right angles to its strike, and a great number of veinlets cross it at right angles and carry little breccia and horses to the original vein. These latter veinlets furnish fine specimens of quartz-gold, and individually give high results. An attempt is being made to ascertain if the whole mass will furnish sufficiently high results to make it a paying proposition.

The same gabbro on the other side of the lake, near a large granite area, carries strong quartz-veins which sometimes yield as much as \$25 to the ton. These veins have a good deal more copper in them than those in the neighboring granite. Fig. 4 shows the series of formations in a generalized section.

It has been stated in some official reports and bulletins that some of the gold-veins occur in the original Laurentian gneiss or granite. I think that this will be found, on thorough investigation, to be a mistake; that the granites in question will be found to be intrusive, and that the semblance of gneissic or schistose structure, observable near the vein, has resulted from local pressure and metamorphic action. The Sultana vein is an example.

In the Seine river section, the most important veins yet developed are in fissures cutting areas of greenish altered granite or protogene (Rock-section No. 6, below). Mining operations are in progress on several of these. In some of the areas the veins are strong and very numerous, but only a very small proportion of them carry enough gold to be mined with profit.

A recent discovery in the altered granite, improperly called a dike, appears to be a large quartz lode, much mixed with altered green chloritic material, and with some finely diffused iron and copper pyrites. On it, the Hammond-Folger locations have been proved to carry some good pay-ore; and it is said that the workable pay-quartz is of great width.

In two well-defined instances, at the Ferguson and William Wiegand locations, crushed or altered country-rock, alluded to as a dike, runs with the vein. Schistose structure has been set up in it. Its composition consists of large pieces of quartz, fine grains of feldspar and muscovite—talc ground-mass; some biotite and accessories of pyrite and calcite. In appearance it is a gray close-grained rock, differing distinctly from the usual protogene.

In Felsitic Bands.—In the Lake of the Woods and Seine districts bands of schistose felsite, composed chiefly of feldspar with a little mica, are sprinkled with small cubes of iron pyrites (Rock-section No. 7, below). These have received a great deal of attention at the hands of prospectors, for frequently they are found to pan a small amount of gold, as a rule just enough to prove an aggravation. Veins of quartz are also found cutting them, and these sometimes carry enough gold to be found profitable; but, again, some of the veins cutting this formation, while mineralized with a good deal of iron pyrites, are yet not rich enough to work profitably.

General Character of Ore.—The gold-bearing quartz in this

old formation might naturally be expected to be peculiarly refractory. Such, indeed, was the impression resulting from the first operations which took place in the Lake of the Woods, and from the first investigation by the Geological Survey of the character of the ores. Much arsenic was reported to have been found, and the gold-values were said to be particularly associated with refractory pyrites, from which they could not be extracted by amalgamation. A couple of mills were started some years ago in the Lake of the Woods district, and the result of their work was very detrimental to the district. Either they ran on an ore which was of too low grade to pay, or ignorance of the principles of milling was the cause of their inability to save the gold.

Recent operations have proved that, in one instance, the ore is free-milling at the depth of more than 200 feet, and, in another instance, that while the ore is free-milling, yet more skill than is at present brought to bear is needed to save fine gold which escapes in the tailings. Cyanide-treatment is about to be used on these tailings, and it should be successful.

To quote a few instances: The result of the working of the Sultana mine up to the present time has been that at least 90 per cent. of the ore has been free-milling. The concentrates, of which from 1 to 2 per cent. are reported to exist in the ore, average from \$30 to \$40 per ton, and are treated by chlorination. A mill-run on the Seine river, from a granite (protogene) area, gave a similar proportion of yield.

As an example of a high yield from a small lot of ore, a mill-test of 114 tons from the Micado mine in the Lake of the Woods district might be quoted. This yielded by free-milling \$7640, or \$67 to the ton, the concentrates not being estimated.

Pan-amalgamation tests from a vein in the protogene gave a little over 90 per cent. of free-milling ore, and the percentage of free-milling extraction from ore occurring in the schists, from near the surface, was also very high.

It must be noted that, with the exception of the Sultana and the Regina in the Lake of the Woods district and the Foley mine in the Seine River district, no considerable depth has yet been reached; but as the above have proved their ore to be entirely free-milling from 200 to 300 feet in depth, the outlook for the district is extremely promising as an area in which

free-milling ores can be mined at a comparatively low cost. It might be expected with reason that the free-milling character in the altered granites would last as far down as the granite has been altered into protogene.

In the Seine River district the veins cutting protogene are found to carry their gold in a very free condition, and in most cases the gold is very coarse. Some ores which carry much pyrites and which might be expected to be more refractory, have shown by milling-tests that they have, as far as sunk upon, the major part of their gold in a free condition.

Some of the veins cutting the protogene are highly mineralized with zinc-blende, iron pyrites and galena, and to a lesser extent with copper pyrites.

The gold-contents do not appear to be influenced by an excessive mineralization; for some of the basest-looking ores, highly charged with the above-mentioned minerals, have proved on assay to run comparatively low in gold-contents, while other veins bearing the same amount of mineral give high results.

It is noted, however, that in cases where mineralization is entirely absent a vein is usually found to be barren in its gold-contents, following the general rule in this regard; and it is also observed that the ore-shoots which carry gold enough to pay to mill are by no means universal, though their proportion is probably equal to that in most other mining districts.

There is little doubt in the mind of the writer that through this great extent of Huronian formation in the Rainy River and Lake of the Woods district, out of the many veins which have already been located (the number of which locations will be immensely increased in the next few years), as large a proportion of paying gold-mines will be developed as are found as an average in successful mining districts.

Conveniences of the District.—The district enjoys very fair transportation-conveniences, which are being constantly improved.

Wages are low in comparison to the west, miners being paid from \$1.50 to \$2.50 per day.

On the Seine river, sinking costs from \$25 to \$40 per foot and drifting by machines about \$10 and hand-drifting \$15 per foot in the granite.

Output.—The gold-yield of the Province of Ontario has been almost entirely from the Rainy River district. The Bureau of Mines gives the following returns of output:

For the year ending October 31, 1893, . . .	\$32,960
" " " 1894, . . .	32,776
" " " 1895, . . .	50,281
" " " 1896, . . .	121,848

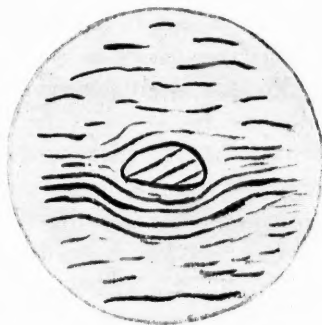
Examples of Country-Rocks.—The following detailed descriptions of specimens of country-rocks, as determined by microscopic examination of prepared sections, may be of interest. The photographs of the slides unfortunately do not bring out the different minerals distinctly, and therefore have not been reproduced here.

FIG. 5.



Schist at Bath Island. Q, quartz;
P, pyrite.

FIG. 6.



Schist at Arrastra Vein, near
Rat Portage.

My thanks are due to Prof. Miller, of the Kingston School of Mining, for assistance in connection with the rock-sections.

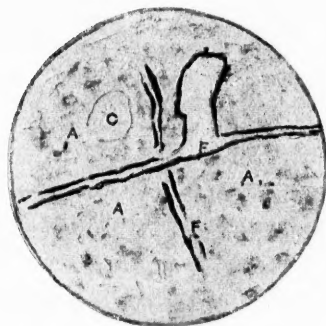
1. A schist (Fig. 5) forming the country-rock at Bath Island, Lake of the Woods, consists of masses of quartz and iron pyrites with a schistose ground-mass, principally of quartz, mixed with untwinned feldspar and a very few streaks of chlorite. The rock has been subjected to great pressure parallel to the vein.

2. A schist, much decomposed, consisting of a fine-grained feldspar, with chloritic masses, a little unaltered pyroxene, some calcite and a number of small specks of pyrite, forms the country-rock of the Lyall mine in the Rainy Lake, the operation of which has been unsuccessful hitherto.

3. A schist (Fig. 6) forming the country-rock at the Arrastra vein, east of Rat Portage, Lake of the Woods, consists of a crushed schistose mass. The chief matrix is feldspar, with some quartz and mica. Streaks or lines of the latter show flow-structure around masses of the original rock from which the schist has been formed. One of these masses showed a bedding, or schistose structure, at an angle of 30° to that of the present structure.

4. A greenstone (Fig. 7) forming the country-rock of Pine Portage mine, Lake of the Woods, is much crushed, and consists chiefly of a crushed matrix of chlorite (resulting from the decomposition of pyroxene), some feldspar and pyroxene. The

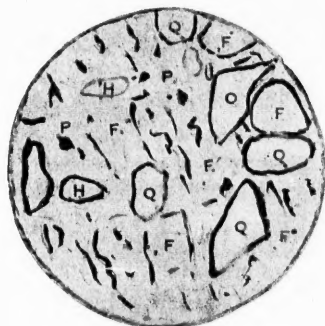
FIG. 7.



Country-Rock, Pine Portage Mine.

A, pyroxene; C, chlorite;
F, feldspar.

FIG. 8.



Country-Rock, Sultana Mine.

F, feldspar; H, hornblende;
P, pyrite.

feldspar is present chiefly as little veinlets. The rock is an altered diabase, which would probably be found at greater depth in its unchanged condition.

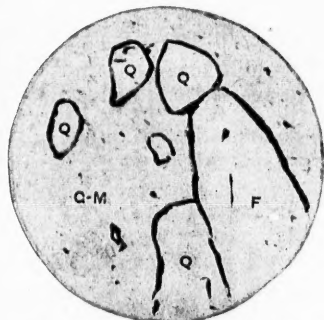
5. The country-rock of the Sultana mine (Fig. 8) shows signs of crushing and alteration. Feldspar is the predominant mineral, both twinned and untwinned with quartz, mica and a little hornblende and pyrite. Where alteration is most apparent the feldspar has been changed into mica, and commences to show a schistose structure. The rock may be a granite (or the "granite" of G. Rose) which has been squeezed by a greenstone upheaval alongside.

The adjacent greenstone mass, which is much decomposed near the surface, is made up for the most part of secondary

hornblende (uralite) and feldspar (twinned and untwinned), with calcite, pyrite and magnetite as accessories. At greater depth it may become evident that the mass is a diabase dike.

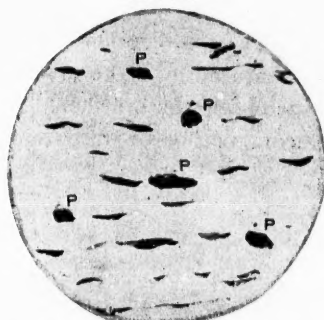
6. An altered granite or protogene (Fig. 9), consisting of masses of quartz, feldspar (chiefly orthoclase) and a greenish ground-mass of talcose and chloritic composition, is representa-

FIG. 9.



Altered Granite or Protogene, Seine River. Q, quartz; F, feldspar; G-M, ground-mass (talc, etc.).

FIG. 10.



Felsitic Schist from Garnier's Island. P, pyrite.

tive of the areas of altered granite which are found to carry a great number of veins in the Seine River district.

7. A felsitic schist from Garnier's Island, Lake of the Woods (Fig. 10), consists of fine-grained feldspar for the most part, some pyrite crystals and a very little mica. This schist changes into a massive felsite dike, consisting of massive fine-grained feldspar, a good deal of pyrite in little masses scattered through it, and a very little mica.

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